

ТЕОРІЯ І ПРАКТИКА ЕКОНОМІКИ ТА УПРАВЛІННЯ ПРОМИСЛОВИМИ ПІДПРИЄМСТВАМИ

THEORY AND PRACTICAL ASPECTS OF ECONOMICS AND INDUSTRIAL ENTERPRISES MANAGEMENT

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METHODS OF SALES FORECASTING IN A MARKETING INFORMATION SYSTEM OF THE INDUSTRIAL ENTERPRISES

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Янковий О.Г., Яшкіна О.І. Методи прогнозування збуту в маркетинговій інформаційній системі промислових підприємств.

У статті запропоновано науково-методичний підхід вибору методу прогнозування збуту інноваційної продукції в залежності від етапу інноваційного процесу. На кожному етапі інноваційного процесу: фундаментальні дослідження, прикладні дослідження, експериментальні роботи, впровадження та дифузія виділено види прогнозів обсягів витрат на інновації та показників результативності інноваційної діяльності. Для кожного з етапів інноваційного процесу визначені джерела отримання прогнозів (експерти або дані поточного продажу) та пов'язані з ними методи прогнозування. Придлено увагу імітаційним методам прогнозування на етапі дифузії інновацій, за якими отримуються окремі прогнози збуту інноваційної продукції.

Ключові слова: інноваційний процес, інноваційна продукція, методи прогнозування збуту, експертні оцінки, дифузія інновацій

Янковой А.Г., Яшкина О.И. Методы прогнозирования сбыта в маркетинговой информационной системе промышленных предприятий.

В статье предложен научно-методический подход выбора метода прогнозирования сбыта инновационной продукции в зависимости от этапа инновационного процесса. На каждом этапе инновационного процесса: фундаментальные исследования, прикладные исследования, экспериментальные работы, внедрение и диффузия выделены виды прогнозов объемов затрат на инновации и показателей результативности инновационной деятельности. Для каждого из этапов инновационного процесса определены источники получения прогнозов (эксперты или данные текущих продаж) и связанные с ними методы прогнозирования. Уделено внимание имитационным методам прогнозирования на этапе диффузии инноваций, по которым получают отдельные прогнозы сбыта инновационной продукции.

Ключевые слова: инновационный процесс, инновационная продукция, методы прогнозирования сбыта, экспертные оценки, диффузия инноваций

Yankovoy A., Yashkina O. Methods of sales forecasting in a marketing information system of the industrial enterprises.

The paper proposes a scientific and methodical approach for choosing a method of innovative products' sales forecasting depending on the stage of the innovation process. For every stage of the innovation process (basic research, applied research, experimental studies, implementation and diffusion) forecast types of volumes of expenses for innovation and performance indicators of innovation are marked. For each of the stages of the innovation process sources of projections (expert review and sales data) and related methods of forecasting are identified. Special attention is paid to method of forecasting simulation at the stage of diffusion of innovations, which are obtained by the individual forecasts of sales of innovative products.

Keywords: innovative process, innovative products, sales forecasting methods, expert review, diffusion of innovations

To collect marketing information on industrial organization in the department of marketing functions marketing information system. The purpose of its functioning is to collect information about factors of marketing environment, analyzing, identifying the need for marketing research and their implementation, as well as forecasting of market reaction to marketing action company. The operation of a marketing information system reduces the risks of decision making in marketing.

Trend life cycle of high-tech products in modern conditions are such that the residence time of the goods in circulation is reduced, but the costs of development and implementation of products in production, on the contrary, increase. Therefore, in our opinion, the development of forecasting tools for marketing the enterprise information system that will provide accurate and reliable forecasts on future sales of products on the market is relevant.

Analysis of recent researches and publications

The scientific approaches to forecasting usually a handful of sales in two groups of methods: expert-based assessments of the experts concerning future sales [1-4]; statistical, based on extrapolation by statistical methods revealed trends for the future [5-7, 13]. In each of these groups there are many approaches for obtaining forecasts of different market situations and methods to assess the reliability of the obtained predictions.

Unsolved aspects of the problem

In our view, the scientific literature does not consider the issues of determination of the forecasting methods used in marketing information system, in connection with the stages of the innovation process.

The aim of the article is the provision of scientific and methodological tools for identifying methods to make predictions in the marketing information system of the industrial enterprise depending on the stage of the innovation process.

The main part

The innovation process consists of several stages: basic research, applied research, experimental work, deployment and diffusion. The first three stages is R&D, the last two commercial phase of the innovation process in which results R&D is perceived or ignored by the market. The information provided by the experts at the first three stages, on projected sales of innovative products, the potential of technology transfer and other indicators of innovative activity has a high degree of "fuzziness", that is, the likelihood that experts in these stages is quite low. In the last two stages of the innovation process, the experts forecasts are more reliable.

At each stage of the innovation process addressed the specific tasks involved and the experts, knowledge, opinions, practical experience and skills which are useful for determining the direction of further actions, management decisions, reducing risks in business, etc. Experts provide projected costs of innovation, and assess the predicted performance indicators of innovative activity (Fig. 1).

At each stage of the innovation process, in addition to the basic research phase, experts provide forecasts on the volume of sold innovation products. For planning of the enterprise activity is extremely important to have such predictions for a certain period. Thus, at the stage of applied research to determine accurate amount of future sales of innovative products that will hit the market in a few years, it is extremely difficult. Such forecasts have a low accuracy, therefore, the formation of strategic development plans of the enterprise for them is high risk.

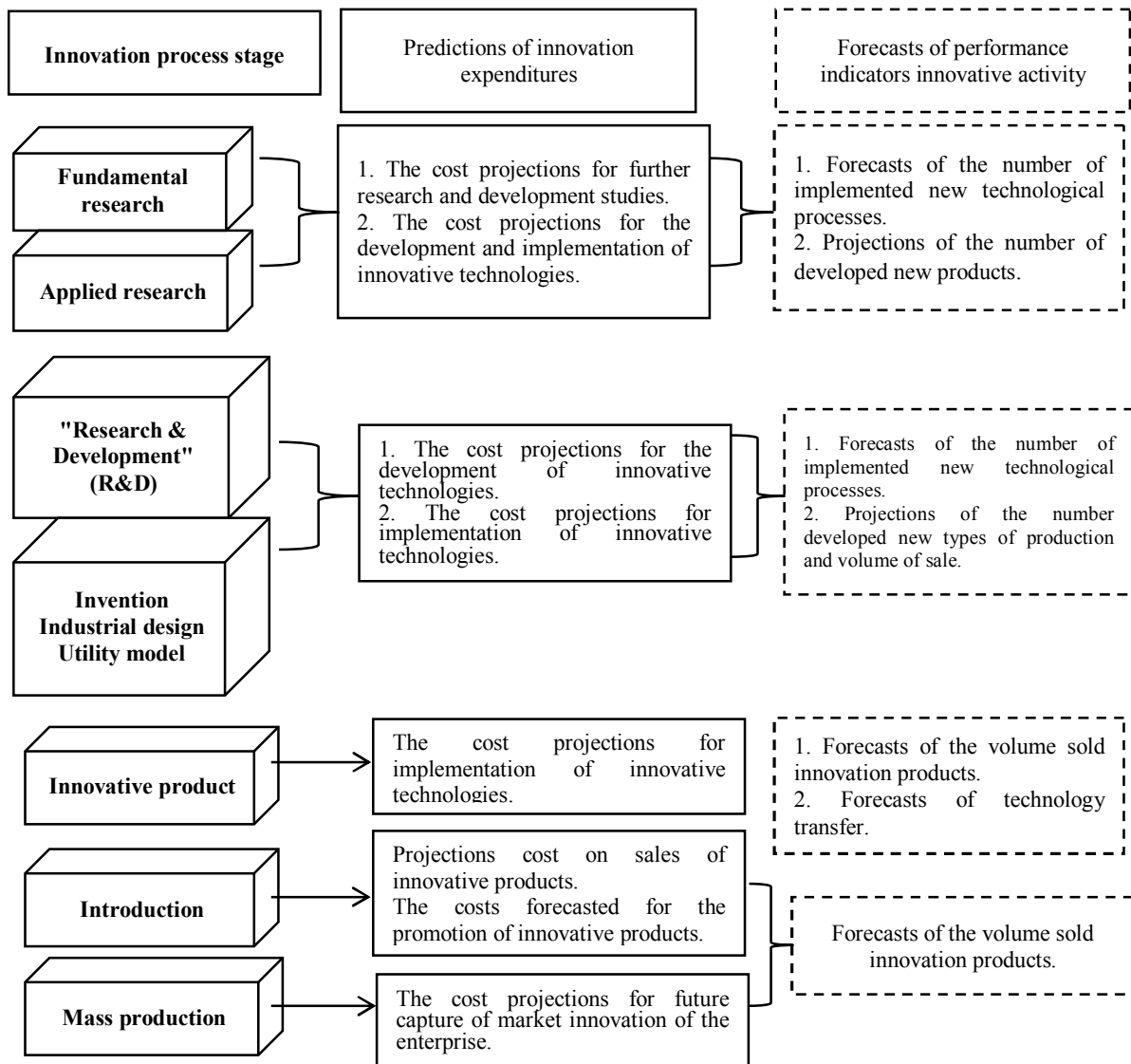


Fig. 1. Forecasts of expenditure on innovation and indicators of innovative performance at each stage of the innovation process

Source: Own elaboration

At the stage of experimental works the situation is more certain. The company is exploring the possibility of introducing innovations in the less distant future. At the implementation stage predictions of volume of sales of innovative products are the most reliable. The company has all the necessary information about the market, about consumers, about the methods of marketing and promotion methods.

At the stage diffusion of innovation (mass production) forecasts are also credible since there is existing information about the sale of the goods, its dynamics and market trends.

To the implementation stage predictions based on expert assessments. Only experts can foresee the future sales of innovative products, based on theoretical knowledge and experience in a specific field of science or production. After the implementation of the marketing department you receive current information that may be used to obtain more reliable predictions (Fig. 2).

It is proposed to choose the tools produce forecasts according to the known information (table 1).

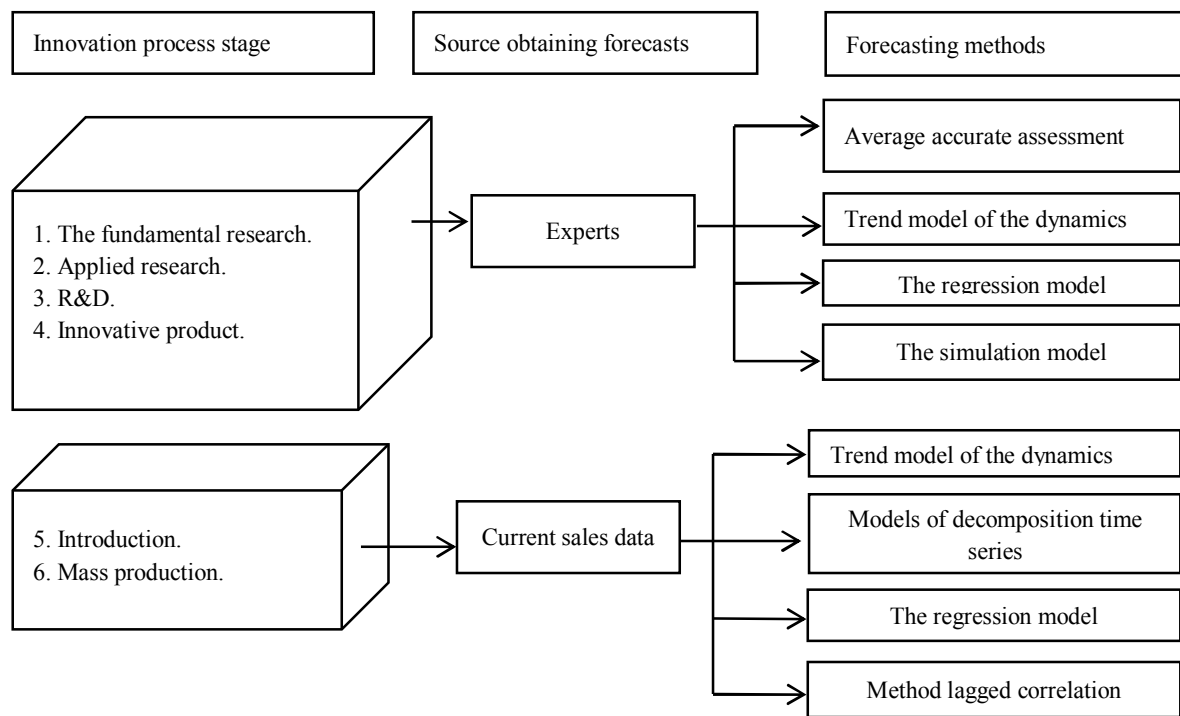


Fig. 2. Source and methods of obtaining the predictions at each stage of the innovation process
Source: Own elaboration

Table 1. Package methods of forecasting sales innovative products according to the known information

Known information	Methods	Innovation process stage	Approaches
Expert assessments of future sales for several periods	Forecasting models for trend dynamics	Applied research R&D Introduction	1. Forecasting by linear trend with the expectation of uniform growth of sales. 2. Forecasting on a parabolic or exponential trend while waiting for the "avalanche" of sales growth. 3. Forecasting exponential and a logarithmic trend in the expectation of slow sales growth.
Current sales data with the seasonally adjusted	Prediction by the decomposition method of time series	Diffusion (mass production)	Forecasting by trend models without seasonality and seasonally adjusted
Expert assessment of future sales and other factors that affect them	Forecasting with regression models of the relationship	Introduction Diffusion	Forecast sales of innovative products based on other factors (cost of marketing, cost of sales, product prices, etc.)
Expert assessment of market capacity, communication efficiency, predictions of the perception market the innovations	simulation model of innovation distribution	Introduction Diffusion	Forecasting sales volumes for the saturation of the market models: — diffuse model Bass the proliferation of goods and technologies; — Gompertz model; — Pearl-R. model.
The data on projected sales and projected changes of interrelated indicators	Forecasting methods for saving lagged correlation	Introduction Diffusion	Forecasting sales of innovative products in connection with the forecasts of other market factors

Source: Own elaboration

Obtaining forecasts using trend dynamics models of a time series using the decomposition method of a time series and using pairwise and multiple regression models is common in the scientific literature [8, 9]. Consider a simulation model of diffusion innovation.

To apply a simulation model of diffusion innovation is at the stage of implementation or diffusion innovation products company. At these stages innovation process, as a rule, more accurately known data on the capacity of the market innovative products and the effectiveness of communication channels.

Simulation models of diffusion innovations in society are based on the classification of future customers innovative products on consumer behaviors. Thus, diffuse model of F. Bass take into account two communication channel for the diffusion innovations in society – advertising and word-of-mouth [10]. All future consumers of innovative products Bass were divided into innovators and imitators. Innovators buy innovative products under the influence of advertising, simulators make purchases under the influence review innovators.

The Bass model consists of differential equations

$$\frac{f(t)}{1-F(t)} = p + qF(t), \quad (1)$$

where $F(t)$ – distribution function;

$f(t)$ – density distribution;

p – innovation coefficient;

q – imitation coefficient.

The volume of sales innovative products in time, $S(t)$, is a function that depends on the density distribution $f(t)$

$$S(t) = mf(t),$$

where m – market capacity.

Substituting the solution of the differential equation (1) into the formula $S(t)$, we obtain

$$S(t) = m \frac{(p+q)^2}{p} \frac{e^{-(p+q)t}}{\left(1 + \frac{q}{p} e^{-(p+q)t}\right)^2}. \quad (2)$$

The time of peak sales on the model of Bass is determined by the formula

$$t^* = \frac{\ln q - \ln p}{p + q}. \quad (3)$$

To apply the Bass model you need to determine the size of the market – m , innovation coefficient – p , and imitation coefficient – q . The innovation coefficient is considered to be the effect of external influence or advertising effect. Usually its value ranges [0-0,03]. The imitation coefficient is considered to be the effect of "word of mouth". Its value varies in the range [0-0,4].

Using the Bass model, the business can predict future sales by simulating the input data. To determine the effect of advertising and the effect of personal contact to build the Bass model by using special marketing research. For example, the effect of advertising is determined by pre-tests, and the effect of personal communication, or the coefficient of imitation, with the help of focus groups.

Gompertz and Pearl-R. model is also S-shaped logistic curves. For curve Gompertz get a trend in the development industries and a series of new products. Gompertz model analytically expressed by the formula [11]:

$$\hat{y} = ka^{b^t}, \quad (4)$$

where a, b – positive parameters with $b < 1$;

k – function asymptote.

In that case, when the projected "avalanche" growth of sales at the stage of market growth, the forecasts used Pearl R. curve. Logistic curve, or Pearl-R. curve – increasing function, often is given by the following formula:

$$\hat{y} = \frac{k}{1+ae^{-bt}}, \quad (5)$$

where a, b – positive parameters;

k – function asymptote.

In both models k – potential market capacity. The model parameters determine the rate of market growth. In these models, not divided separately the effect of advertising and the effect of "word of mouth". To determine the parameters of the models, usually based on the forecast of sales in the "zero" point and after a certain period of time.

Forecasting sales of innovative products in relation to other market factors enables to obtain a forecast that is balanced with the determining factor of the sale. For example, the forecast sales of components for computers interconnected with the forecast growth in demand for computers. To obtain balanced forecasts it is recommended to apply conservation methods lagged correlation [12].

For a measure that indicates the deviation coefficient of correlation lags computed from the actual points, from the same ratio, but calculated with the accession of the forecast points, was adopted by the following value:

$$K = R_{x_1x_2}(\eta) - r_{x_1x_2}(\eta), \quad (6)$$

where $R_{x_1x_2}(\eta)$ – lagged correlation coefficient calculated on the actual levels of the economic indicator series.

$r_{x_1x_2}(\eta)$ – lagged correlation coefficient calculated on the actual levels of the economic indicator series with the accession of the forecast points.

The value K is called deviation criterion lagged correlation. The best pair of trends for forecasting economic indicators invited to consider one whose deviation criterion lagged correlation minimum.

Conclusions

In marketing information system of the industrial enterprise necessarily apply methods of forecasting sales of innovative products, at each stage of the innovation process have certain features. To receive forecasts of sales of innovative products it is necessary to apply the methods of forecasting by expert estimations, methods of forecasting by statistical methods, and also methods make predictions by methods of simulation modeling.

Abstract

On the industrial enterprise the process of collecting information about factors of marketing environment, its analysis, determination of the need for marketing studies and their implementation, as well as forecasting market reaction to the marketing activities of the enterprise is provided by marketing information system. Using forecasting techniques in marketing information system management decisions should be taken at all stages of the innovation cycle. Purpose of the article is to provide scientific and methodological tools of determination of forecasting methods in marketing information system for industrial enterprises, depending on the stage of the innovation process.

When choosing the method of forecasting sales of innovative products it is offered to perform depending on the stage of the innovation process. At each stage of the innovation process (basic research, applied research, experimental studies, implementation and diffusion) forecast types of volumes of expenses for innovation and performance indicators of innovation are marked. For each stage of the innovation process by forecasting sources (experts or current sales) and related methods of forecasting. At the stage of diffusion forecasting sales of innovative products is recommended predict by simulation methods. Some forecasts of sales of innovative products are provided by model Gompertzian, Pearl-Reed model or a model of innovation diffusion Bass. Projections interrelated with other factors are obtained by the method of lagged correlation.

Forecasting sales of innovative products demands the use of methods of expert estimates, forecasting methods for the statistical methods and methods for example by means of simulation.

JEL Classification: C53, D48.

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